U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Center for Coastal Fisheries and Habitat Research
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Comparative analysis of the functioning of disturbed and undisturbed coral reef and seagrass ecosystems in the Tortugas: Phase I- Establishing a baseline

Progress Report # 4

March 1, 2001

and Cruise Report for Leg 4 of

NOAA Ship OREGON II Cruise OT-01-01
04 January 2001 - 13 February 2001

Submitted By:

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September 1, 2000

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INTRODUCTION

The year 2001 may see the implementation of the Tortugas Ecological Reserve. If approved, it will include two components: Tortugas North and Tortugas South (Figure 1). Tortugas North is approximately 151 nm^2 and covers the northern half of Tortugas Bank, Sherwood Forest, the pinnacle reefs north of the bank, and extensive low relief areas in the 15-40 m depth range. The latter low relief areas have received little assessment. Tortugas South is approximately 60 nm^2 and encompass Riley's Hump as well as deep water habitats to the south which are reported to provide critical habitat for several snapper species, snowy grouper, tilefish, and golden crab. The implementation of this reserve provides an excellent opportunity for NOAA to investigate the effects of human disturbance (e.g., elimination of consumptive sampling and physical impacts) on the functioning of coral reef and deepwater algal and seagrass ecosystems. Specifically, to determine the efficacy of this management action, several long-term monitoring actions must be taken, including evaluating the local and regional areas in terms of larval fish export, changes in adult fish biomass, and especially, changes in ecosystem structure and associated ecological processes.

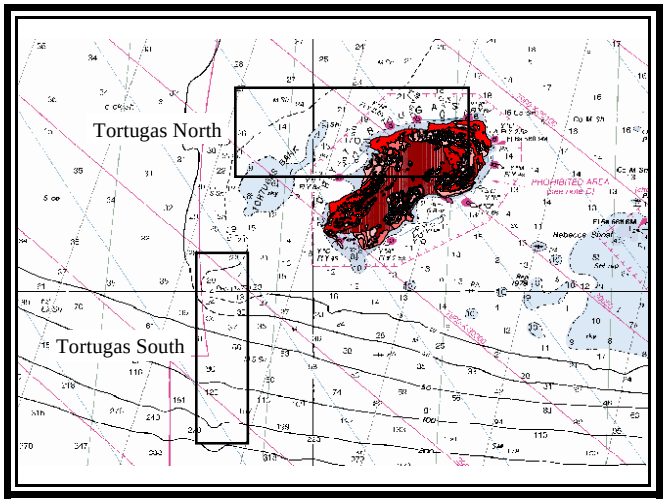

Figure 1. Location of the Ecological Reserve boundaries in the Dry Tortugas.

The National Centers for Coastal Ocean Science, here headed by the Center for Coastal Fisheries and Habitat Research (CCFHR) and our colleagues both in and out of NCCOS (Center for Coastal Monitoring and Assessment, Coastal Services Center, Florida Marine Research Institute, National Undersea Research Center, and the University of South Florida)are uniquely poised to provide critical mission support to habitat characterization and marine reserve questions that are facing the Tortugas Ecological Reserve (TER) within the Florida Keys National Marine Sanctuary (FKNMS). CCFHR has researched fishery-habitat interactions in south Florida and the Keys since the early 1980's and brings a wide range of scientific expertise to bear on fisheries and habitat issues. Moreover, we are coordinating this work with the research approach and philosophy of applied studies of our other studies in the region - including injury recovery experiments, monitoring and modeling in the FKNMS, linkages among coral reefs and adjacent habitats in Puerto Rico, EFH funding on the contribution of deepwater primary producers to coastal fisheries and gear impact studies, and long-term studies of icthyoplankton distribution, development and transport mechanisms.

The need for detailed habitat characterization is inextricably linked with the reserve issue. Many reef fishes leave the structure of the reef at night to forage in the adjacent sand, algal and seagrass flats, thereby importing significant amounts of nutrients onto the reef environment, contributing to its high productivity. This mass transfer also ultimately contributes to energy requirements of small grazers that cannot themselves access the adjacent, non-coral reef resources. The adjacent seagrass beds are also significant settlement areas for post-larval reef fishes. Over-fishing of the diurnally migrating fishes and/or physical damage to the foraging/settlement environment could significantly alter the reserve's productivity and biological diversity. Therefore, habitat characterization is critical to determine the distribution of sessile resources that are susceptible to injury and which may be poised to rebound once any injury activity is relaxed through implementation of the reserve. Habitat characterization is also crucial to ultimately determine an ecologically optimal size of the reserve complex (i.e., the reef and the adjacent areas upon which reef fauna are dependent) to yield optimum fishery production and maintain the ecological health of the reef ecosystem. Finally, conducting work in the TER provides a unique opportunity

to compare the structure and function of a relatively undisturbed system with those elsewhere in the FKNMS and adjacent waters. This comparative approach has significant potential for translating the findings of these studies so as to apply them directly to management issues in other NOAA trust resources.

In support of this research, the NOAA Ship OREGON II arrived in Jacksonville, FL on 03 January 2001 to support research objectives of the CCFHR and collaborators (CCMA, CSC, FMRI, NURC, USF) on the southwest Florida continental shelf and the Dry Tortugas Ecological Reserve. This marked the final leg of a three week excursion for the OREGON II. A total of eight scientists representing three federal and state institutions participated in the final leg.

OBJECTIVES

Programmatic: Over the three year period of this work, we have proposed:
1) a preliminary characterization and inventory of the benthic habitat and fish communities in the extreme depths of the Tortugas South reserve component;
2) characterization of spawning aggregations and initiating the development of a probabilistic model of the fate of snapper larvae, focusing on Riley's Hump;
3) beginning comparative characterization of shallow and deepwater seagrass communities and their contribution to fishery resources in disturbed (outside the reserve) and undisturbed sites (inside the reserve);
4) establishment of a baseline for benthic nutrient composition and flux in disturbed and undisturbed sites;
5) determination of the accuracy of existing habitat delineations within the proposed ecological reserve as a function of depth and disturbed and undisturbed sites;
6) examination of how high resolution ecological data of a given habitat type can be scaled to the larger spatial context of the proposed ecological reserve.

Cruise OT-01-01: Here, our objectives were to:
1) Collect comparative data of resident invertebrate, fish and plant populations as part of ongoing Essential Fish Habitat (EFH) research on the west Florida shelf and as part of the Florida Keys National Marine Sanctuary (FKNMS) effort to assess the efficacy of the institution of an Ecological Reserve at the Dry Tortugas.
2) Conduct extensive habitat characterizations of the Dry Tortugas Ecological Reserve areas in comparison with areas outside the proposed Reserve.
3) Ground truth digital video tows of the seafloor using various sampling mechanisms, including ROV, and TOV.
4) Determine food web linkages and the functional extent of the coral reef / soft bottom community.
5) Conduct collections and primary production measurements of various seagrass species.

Cruise Component:	05 February 2001	Departed Jacksonville, FL
	13 February 2001	Arrived Pascagoula, MS

-continued video and sonar mapping along defined transects up to ~3 km length using Quester Tangent SeaView and ROXANN sonar systems in combination with drop cameras during drifts and towed MiniBat; conducted Ponar grab sampling of sediments at selected stations along the aforementioned video transects; deployed divers to collect sediment cores during MiniBat tows; collected incident radiation and measures of water clarity; at the west Florida shelf, deployed divers to collect *Halophila* seed cores in addition to sediment cores during MiniBat tows

Cruise Participants:

Name	Title	Affiliation
Mark Fonseca	Chief Scientist	NOS, Beaufort, NC
Amy Uhrin	Field Party Chief	NOS, Beaufort, NC
John Brewer	Biological Technician	NOS, Beaufort, NC
Donald Field	Geographer	NOS, Beaufort, NC
Mark Finkbeiner	Geographer	CSC, Charleston, SC
Donna Berns	Biologist	FMRI, St. Petersburg, FL
Jitka Hyniova	Biologist	FMRI, St. Petersburg, FL
Manuel Merello	Biologist	FMRI, St. Petersburg, FL

DRY TORTUGAS ECOLOGICAL RESERVE (NORTH)

Station Location and General Survey Work: Due to vessel restrictions, our sampling was confined to the west Tortugas Bank (Figure 2). Extensive benthic mapping(video transects) within this area was conducted using a MiniBat TOV housing a camera and Quester Tangent SeaView sonar system in combination with a ROXANN sonar system. We will transfer the video-based record of benthic cover at 1 m resolution into a Geographic Information System (GIS: ArcView). The GIS will be used to develop maps of benthic cover to guide the placement of fish censuses, transects, and trawls during the June/July cruise. Ponar grab samples of sediments were taken at selected stations along the aforementioned video transects. Divers were deployed to extract sediment cores in conjunction with the grab samples or during MiniBat towing. Incident radiation and measures of water clarity were taken when appropriate.

Approach (Specific): Based upon our extensive habitat characterization of this area during the FE-00-09-BL cruise in the summer of 2000, we chose to adopt a sampling protocol that focused on habitat interfaces (i.e. areas where coral reef meets seagrass/algal plains). Our video interpretations and drop camera work from the previous year revealed areas of potential interfaces. Each of these areas was designated as one of six categories: Out North (outside the reserve/park, north of the prevailing current) Out South (outside the reserve/park, south of the prevailing current), Park North (inside the park, north of the prevailing current), Park South (within the park, south of the prevailing current), Reserve North (within the reserve, north of the prevailing current), and Reserve South (within the reserve, south of the prevailing current, Figure 2). Due to vessel restrictions, our work was limited to the west bank. Five random sample points were selected from within each of the six categories (Red circles with diagonal lines, Figure 3). At each sample point we conducted extensive benthic mapping using a MiniBat® TOV housing a vertically-mounted camera and Quester Tangent SeaView® sonar system (Figure 4). An additional sonar system (ROXANN®) was deployed on some of the transects and run simultaneously with the MiniBat unit. Three passes of approximately 1 km in length and separated by a distance of ~ 1 km were made at each point (Figure 4). Three additional sets of transects were made at the northern boundary of the reserve

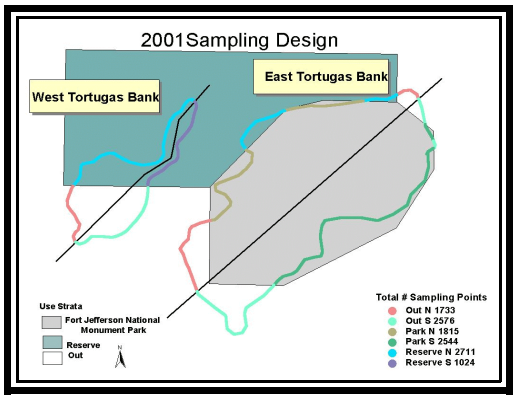

Figure 2. Sample stratification for Dry Tortugas sampling in 2001.

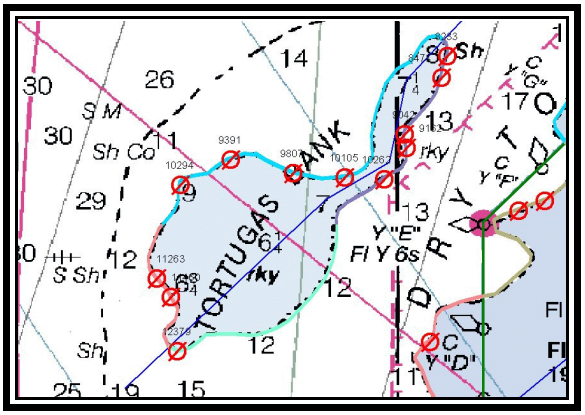

Figure 3. Potential randomly selected sites along strata (blue triangles). Random subsets chosen for surveying are represented by red triangles.

(Figure 4). All data collections were georeferenced and time-stamp coordinated. We will transfer the video-based record of benthic cover from each transect by randomly sub-sampling positions at 1 m resolution, inspecting the georeferenced video tape, and recording the seafloor composition into a GIS. The GIS will be used to select additional sites for more intensive sampling (i.e. fish counts, trawls, sediment samples, etc.) during the summer 2001 cruise.

Grab Sampling and Diving: Ponar grab sediment samples were taken at select stations along the aforementioned video transects. The samples were processed on deck for compaction and shear strength with additional cores removed for sediment particle size and benthic chlorophyll. On one occasion, divers were deployed to extract sediment cores and to take compaction and shear measurements.

Ancillary Data: We collected incident radiation and measures of water clarity at select stations along the aforementioned video transects. We recorded the GIS tracks of all tows, as well as drop camera, Ponar grab, incident radiation and water clarity stations. A complete listing of all data/samples collected is given in Appendix I.

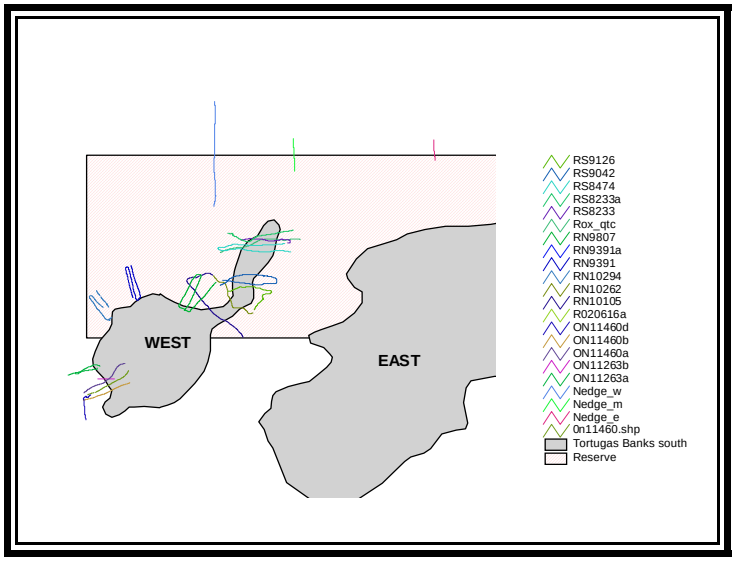

Figure 4. Tow tracks of MiniBat / sonar systems.

WEST FLORIDA SHELF

Station Location and General Survey Work: On February 10, the ship steamed to our 1 km^2 stations located on the west Florida shelf. On February 11, divers were deployed at the midshore station (MS) to extract *Halophila* seed cores and sediment cores. The midshore station was re-mapped using the MiniBat and sonar systems (for a more detailed background on this site and the project, see: "Essential Fish Habitat Project: Deepwater seagrass beds of the west Florida Shelf an overlooked essential fish habitat. Progress Report." in .pdf format, located at: http://shrimp.bea.nmfs.gov/admin/labpubs.html).

APPENDIX I. Dive Statistics

Date	Divers	Location	Max Depth (ft)	Bottom Time (min)	Medium
2/10/01	Manuel Merello	Dry Tortugas	80	27	NITROX II
	Jitka Hyniova				
2/10/01	Mark Fonseca	Dry Tortugas	93	29	NITROX II
	Amy Uhrin				
	Nick Toth (crew)				
2/11/01	Mark Fonseca	west FL shelf	47	18	21% O_2
	Jitka Hyniova				
2/11 01	Amy Uhrin	west FL shelf	47	21	21% O_2
	Jitka Hyniova				
2/11/01	Amy Uhrin	west FL shelf	48	22	21% O2
	Mark Fonseca				

APPENDIX II. Sample Codes

benthic chl	**CHL_BEN**
MiniBat tow	**BAT**
drop camera	**DROP**
video sled	**SLED**
light profile	**LGT**
Secchi disk	**SEC**
QTC view	**QTC**
ROXANN	**ROX**
waypoint	**WPT**
PONAR grab	**PONAR**
Smith-Mac grab	**SMAC**
sediment torque	**SED_TRQ**
sediment penitrometry	**SED_PEN**
sediment sheer	**SED_SHR**
sediment particle size	**SED_PART**
Super VHS video	**SVHS**
regular VHS video	**VHS**
ASPEN file	**ASP**
seed cores	**SEED**

APPENDIX II. Complete Listing of All Data/Samples

Date	Start Time	Sample Code	Strata	Latitude	Longitude
2/7/01	17:49:11	QTC/BAT/ASP	OUT S	24 35.9972	83 05.1472
2/7/01	17:49:11	SVHS	OUT S	24 35.9972	83 05.1472
2/7/01	17:49:11	VHS	OUT S	24 35.9972	83 05.1472
2/7/01	19:04:39	QTC/BAT/ASP	OUT S	24 35.9402	83 05.0370
2/7/01	19:04:39	SVHS	OUT S	24 35.9402	83 05.0370
2/7/01	19:04:39	VHS	OUT S	24 35.9402	83 05.0370
2/7/01	20:03:24	BAT/ASP	OUT N	24 36.8332	83 05.9438
2/7/01	20:03:24	SVHS	OUT N	24 36.8332	83 05.9438
2/7/01	20:03:24	VHS	OUT N	24 36.8332	83 05.9438
2/7/01	20:51:09	BAT/ASP	OUT N	24 38.0335	83 04.5876
2/7/01	20:51:09	SVHS	OUT S	24 38.0335	83 04.5876
2/7/01	20:51:09	VHS	OUT S	24 38.0335	83 04.5876
2/7/01	22:00:50	BAT/ASP	OUT N	24 36.373	83 06.667
2/7/01	22:00:50	SVHS	OUT N	24 36.6095	83 06.1249
2/7/01	22:00:50	VHS	OUT N	24 36.6095	83 06.1249
2/7/01	23:25:37	DROP	OUT N	24 36.8228972	83 05.8426748
2/8/01	13:10:12	QTC/BAT/ASP	OUT N	24 37.5637	83 06.7452
2/8/01	13:51:57	QTC/BAT/ASP	OUT N	24 37.9357	83 05.5245
2/8/01	13:51:57	SVHS	OUT N	24 37.9357	83 05.5245
2/8/01	13:51:57	VHS	OUT N	24 37.9357	83 05.5245
2/8/01	15:57:00	LGT	OUT N	24 36.603	83 06.063
2/8/01	15:57:00	SEC	OUT N	24 36.603	83 06.063
2/8/01	15:20:00	PONAR	OUT N	24 37.7077	83 06.2814
2/8/01	15:20:00	SED_PART	OUT N	24 37.7077	83 06.2814
2/8/01	15:36:00	PONAR	OUT N	24 36.654	83 06.063
2/8/01	15:54:00	PONAR	OUT N	24 36.603	83 06.042
2/8/01	15:54:00	SED_PART	OUT N	24 36.603	83 06.042
2/8/01	16:20:00	PONAR	OUT S	24 36.747	83 06.124
2/8/01	16:20:00	SED_PART	OUT S	24 36.747	83 06.124
2/8/01	16:38:11	ASP/BAT/QTC	OUT N	24 37.4439795	83 05.5911025
2/8/01	16:47:53	SVHS	OUT N	24 37.4439795	83 05.5911025
2/8/01	16:47:53	VHS	OUT N	24 37.4439795	83 05.5911025
2/8/01	17:51:16	ASP/BAT/QTC	RESERVE N	24 40.1712421	83 05.3980895
2/8/01	17:55:51	SVHS	RESERVE N	24 40.1712421	83 05.3980895
2/8/01	17:55:51	VHS	RESERVE N	24 40.1712421	83 05.3980895
2/8/01	18:19:37	SVHS	RESERVE N		
2/8/01	18:19:37	VHS	RESERVE N		
2/8/01	18:47:07	ASP/BAT/QTC	RESERVE N	24 40.191256	83 05.193833
2/8/01	18:47:07	SVHS	RESERVE N	24 40.191256	83 05.193833
2/8/01	18:47:07	VHS	RESERVE N	24 40.191256	83 05.193833
2/8/01	19:27:37	ASP/BAT/QTC	RESERVE N	24 40.5581	83 04.2840598
2/8/01	20:18:43	SVHS	RESERVE N	24 40.5581	83 04.2840598
2/8/01	20:18:43	VHS	RESERVE N	24 40.5581	83 04.2840598

2/8/01	20:48:25	ASP/BAT/QTC	RESERVE N	24 40.0485241	83 02.4008212
2/8/01	21:25:06	SVHS	RESERVE N	24 40.0485241	83 02.4008212
2/8/01	21:25:06	VHS	RESERVE N	24 40.0485241	83 02.4008212
2/8/01	21:57:06	SVHS	RESERVE N		
2/8/01	21:57:06	VHS	RESERVE N		
2/8/01	22:15:57	VHS	RESERVE N		
2/8/01	22:19:22	SVHS	RESERVE N		
2/8/01	22:19:22	VHS	RESERVE N		
2/8/01	22:27:30	SVHS	RESERVE N		
2/8/01	22:27:30	VHS	RESERVE N		
2/8/01	23:50:02	ASP	RESERVE N	24 41.552	83 04.114
2/8/01	23:51:59	DROP/WPT	RESERVE N	24 41.540	83 04.159
2/8/01	23:51:59	SHVS	RESERVE N	24 41.540	83 04.159
2/8/01	0:01:28	DROP/WPT	RESERVE N	24 41.512	83 04.301
2/8/01	23:59:59	SHVS	RESERVE N	24 41.512	83 04.301
2/8/01	0:21:40	DROP/WPT	RESERVE N	24 41.508	83 04.081
2/8/01	0:19:32	SHVS	RESERVE N	24 41.508	83 04.081
2/8/01	0:44:53	DROP/WPT	RESERVE N	24 41.354	83 04.385
2/8/01	0:41:49	SHVS	RESERVE N	24 41.354	83 04.385
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2/9/01	13:14:33	SVHS	RESERVE S		
2/9/01	13:14:33	VHS	RESERVE S		
2/9/01	14:00:00	BAT	RESERVE S		
2/9/01	14:24:37	ASP/BAT/QTC	RESERVE S	24 41.3799979	83 01.3140439
2/9/01	14:25:28	SVHS	RESERVE S		
2/9/01	14:25:28	VHS	RESERVE S		
2/9/01	15:04:47	ASP/BAT/QTC	RESERVE S	24 40.0946822	82 59.7918399
2/9/01	14:25:28	SVHS	RESERVE S		
2/9/01	14:25:28	VHS	RESERVE S		
2/9/01	15:27:00	BAT	RESERVE S		
2/9/01	15:27:00	SVHS	RESERVE S		
2/9/01	15:27:00	VHS	RESERVE S		
2/9/01	16:10:58	ASP/BAT/QTC	RESERVE S	24 41.2047572	83 00.9774109
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2/9/01	16:10:57	VHS	RESERVE S		
2/9/01	18:40:32	ASP/QTC/BAT/ROX	RESERVE S	24 42.2880800	82 58.4562930
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2/9/01	18:40:38	VHS	RESERVE S		
2/9/01	20:08:30	ASP/QTC/BAT/ROX	RESERVE S	24 42.6304900	82 58.5662934
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2/9/01	20:08:30	VHS	RESERVE S		
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2/9/01	21:16:05	VHS	RESERVE S		
2/9/01	22:17:08	DROP/WPT	RESERVE S	24 43.103	82 58.524

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2/9/01	22:50:23	SVHS	RESERVE S	24 42.6418627	82 58.9079622
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2/9/01	22:17:08	SVHS	RESERVE S	24 42.3371915	82 59.9263943
2/9/01	23:27:54	DROP/WPT	RESERVE S	24 42.8659204	82 59.9703081
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2/10/01	17:20:50	VHS	RESERVE		
2/10/01	18:22:41	ASP/QTC/BAT/ROX	NBOUND	24 44.0295627	83 01.2882047
2/10/01	20:40:52	DROP	NBOUND	24 45.8068038	82 58.4594004
2/10/01	20:40:52	SVHS	NBOUND	24 45.8068038	82 58.4594004

2/10/01	20:14:00	PONAR	NBOUND	24 46.770	82 59.290
2/10/01	20:14:00	CHL_BEN	NBOUND	24 46.770	82 59.290
2/10/01	20:14:00	CHL_BEN	NBOUND	24 46.770	82 59.290
2/10/01	20:14:00	CHL_BEN	NBOUND	24 46.770	82 59.290
2/10/01	20:14:00	SED_PART	NBOUND	24 46.770	82 59.290
2/10/01	20:14:00	SED_PEN	NBOUND	24 46.770	82 59.290
2/10/01	20:14:00	SED_SHR	NBOUND	24 46.770	82 59.290
2/10/01	20:28:00	PONAR	NBOUND	24 45.777	82 58.375
2/10/01	20:28:00	CHL_BEN	NBOUND	24 45.777	82 58.375
2/10/01	20:28:00	CHL_BEN	NBOUND	24 45.777	82 58.375
2/10/01	20:28:00	CHL_BEN	NBOUND	24 45.777	82 58.375
2/10/01	20:28:00	SED_PART	NBOUND	24 45.777	82 58.375
2/10/01	20:28:00	SED_PEN	NBOUND	24 45.777	82 58.375
2/10/01	20:28:00	SED_SHR	NBOUND	24 45.777	82 58.375
2/10/01	21:10:18	ASP/QTC/BAT/ROX	NBOUND	24 45.3844378	82 58.2947970
2/10/01	22:32:40	PONAR	NBOUND	24 46.071871	82 53.1316226
2/10/01		CHL_BEN	NBOUND	24 46.071871	82 53.1316226
2/10/01		CHL_BEN	NBOUND	24 46.071871	82 53.1316226
2/10/01		CHL_BEN	NBOUND	24 46.071871	82 53.1316226
2/10/01		SED_PART	NBOUND	24 46.071871	82 53.1316226
2/10/01		SED_PEN	NBOUND	24 46.071871	82 53.1316226
2/10/01		SED_SHR	NBOUND	24 46.071871	82 53.1316226
2/10/01	22:43:40	PONAR	NBOUND	24 460224494	82 53.0777516
2/10/01		CHL_BEN	NBOUND	24 460224494	82 53.0777516
2/10/01		CHL_BEN	NBOUND	24 460224494	82 53.0777516
2/10/01		CHL_BEN	NBOUND	24 460224494	82 53.0777516
2/10/01		SED_PART	NBOUND	24 460224494	82 53.0777516
2/10/01		SED_PEN	NBOUND	24 460224494	82 53.0777516
2/10/01		SED_SHR	NBOUND	24 460224494	82 53.0777516
2/10/01		DROP	NBOUND	24 45.9986965	82 53.1800344
2/10/01		SVHS	NBOUND		
2/10/01	23:15:13	ASP/QTC/ROX	NBOUND	24 45.7941960	82 53.1168716
2/10/01		random site	NBOUND	24 46.0500008	82 53.1420009
2/10/01		random site	NBOUND	24 45.9959986	82 58.3439989
2/10/01		random site	NBOUND	24 45.9779989	83 01.2179995
2/11/01	13:42:00	SEED	FLASH	25 07.8064776	81 44.2067559
2/11/01	13:42:00	SED_PEN	FLASH	25 07.8064776	81 44.2067559
2/11/01	13:42:00	SED_TRQ	FLASH	25 07.8064776	81 44.2067559
2/11/01	14:40:00	SEED	FLASH	25 07.8576235	81 43.9835396
2/11/01	14:40:00	SED_PEN	FLASH	25 07.8576235	81 43.9835396
2/11/01	14:40:00	SED_TRQ	FLASH	25 07.8576235	81 43.9835396
2/11/01	15:46:00	SEED	FLASH	25 07.7555540	81 44.6558791
2/11/01	15:46:00	SED_PEN	FLASH	25 07.7555540	81 44.6558791
2/11/01	15:46:00	SED_TRQ	FLASH	25 07.7555540	81 44.6558791
2/11/01	15:58:00	LGT	FLASH	25 07.626	81 44.216

2/11/01	13:49:01	ASP/BAT/QTC/ROX	FLASH	25 08.1319455	81 44.5390882
2/11/01	13:42:20	SVHS	FLASH		
2/11/01	13:42:20	VHS	FLASH		
2/11/01	14:22:26	ASP/BAT/QTC/ROX	FLASH	25 07.8058781	81 44.6622434
2/11/01	14:22:28	SVHS	FLASH		
2/11/01	14:22:28	VHS	FLASH		
2/11/01	14:40:21	SVHS	FLASH		
2/11/01	14:40:21	VHS	FLASH		